

Editorial

Echocardiographic assessment of long axis function: a simple solution to a complex problem?

Circumferential fibre shortening has formed the dominant basis for the conventional analysis of left ventricular function by echocardiography with measurement of ventricular dimensions, ejection fraction, and fractional shortening; however, the complexity of ventricular architecture has been recognised by anatomists for almost two centuries. The presence of additional myocardial fibres oriented in the longitudinal direction and located in the subendocardial, trabecular, and papillary muscle regions of the ventricle¹ has also led to an interest in echocardiographic assessment of the left ventricular long axis function. As there is a constant relation between the cardiac and the chest wall, displacement of the atrioventricular plane towards the apex is a direct reflection of longitudinal fibre contraction. Accurate measurement of this displacement at the anterior, posterior, lateral, and medial aspect of the atrioventricular ring is possible using two dimensionally guided M mode echocardiography from the apical two and four chamber views, allowing information on both regional and global left ventricular function, the latter measured as an average displacement from all four planes.²

Long axis function

Abnormalities in long axis systolic function occur in a variety of pathological conditions including myocardial infarction,² coronary artery disease,³ cardiac failure,⁴ and systemic sclerosis.⁵ Functional abnormalities of the ventricular long axis are not limited to reduction in systolic contraction but may manifest as diastolic abnormalities or alterations in the interaction with circumferential short axis fibres. Incoordination between long and short axis function⁶ in ventricular disease can result in asynchrony of left ventricular relaxation and associated filling abnormalities. Long axis shortening usually occurs before any short axis contraction, causing the ventricle to become more spherical during the phase of isovolumetric contraction; however, in ventricular disease, particularly where there is subendocardial ischaemia predominantly affecting the long axis fibres, ventricular shape changes occur resulting in a less efficient and more incoordinated ventricular contraction.⁷

Long axis function and ejection fraction

There is a clear relation between long axis function and ejection fraction²⁻⁴ but atrioventricular plane displacement (AVPD) has a number of potential advantages. It can be obtained from the apical views, which allow satisfactory imaging in the vast majority of patients yet it is not limited by the need for accurate endocardial border identification, notoriously difficult particularly in elderly patients. In addition, AVPD is a highly reproducible measurement even when performed by relatively inexperienced operators.⁸ However, the wealth of data relating ejection fraction to prognosis in left ventricular dysfunction has ensured that this remains the most widely applied

echocardiographic assessment of global left ventricular function. An article published in this edition of *Heart* is the first available evidence that AVPD, in a similar manner to ejection fraction, may also provide prognostic information in patients with significant left ventricular dysfunction.⁹ Although ejection fraction was not measured in this study, the assessment of echo quality highlights the fact that AVPD may be more widely applicable to this patient population being readily obtained in all of the patients studied, whereas two dimensional imaging of sufficient quality to measure ejection fraction was possible in only 77% of cases. Mortality is significantly higher when the AVPD is less than 10 mm with a substantial mortality increase when AVPD is less than 7 mm.

The similarity between AVPD and ejection fraction techniques for the assessment of global left ventricular function is readily apparent but they may not produce identical information. Long axis fibres are mainly subendocardial and more prone to ischaemia, implying that abnormalities of AVPD may occur earlier in the disease process and represent more subtle alterations in ventricular function. It may also better reflect global function by deriving information from four distinct ventricular regions and may ultimately prove to be a more accurate prognostic indicator than ejection fraction. The relation between AVPD and prognosis in patients with left ventricular dysfunction requires further confirmation and there remains a lack of data on normal AVPD at different ages and with alterations in posture. Its value for serial investigation remains unclear, however, the excellent reproducibility of the technique tends to suggest that it would be ideally suited to serial application.

AVPD and left ventricular function

Despite the major advances in cardiac ultrasound image acquisition and analysis in recent years, the conventional assessment of left ventricular function remains subject to many limitations. It requires high definition endocardial border detection—still possible in only a proportion of patients—as well as careful attention to analysis techniques. Echocardiographic assessment of long axis left ventricular function may not provide the complete answer for ventricular function assessment and it is unlikely to displace conventional and well established techniques. With improved image resolution and the prospect of three dimensional echocardiography, accurate measurement of left ventricular function by echocardiographic techniques will continue to improve. However, this reproducible, widely applicable, and potentially important prognostic technique may yet prove the match of more sophisticated function analysis. Its beauty lies in its simplicity.

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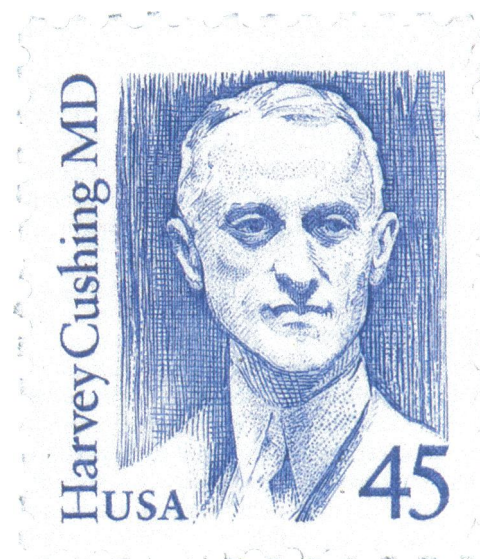
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STAMPS IN CARDIOLOGY

Harvey Williams Cushing (1869-1939)

This 45 cent stamp was issued by the USA on 17 June 1988 as a further addition to the Great Americans series. On the stamp's official first day cover for the American Association of Neurological Surgeons (founded as the Harvey Cushing Society in 1931) it is stated that the stamp was issued "for the work that he did and for his many contributions to the medical profession, and to American society".

Harvey Williams Cushing was a great neurosurgeon, famous especially for his surgery of the pituitary gland and for his description of the syndrome caused by a basophil adenoma of the gland. Cushing's syndrome causes serious heart disease, chiefly through hypertension and coronary atheroma as well as the effects of an excess of cortisol, aldosterone, and androgens. Congestive heart failure occurs in 25% and its poor response to treatment has led to the syndrome being called a killer disease. In 1908 Cushing carried out pioneer work in experimental cardiac surgery (*Journal of Medical Research* 1908;17:471-85). He was the first to produce valve lesions (in dogs) systematically rather than by blind instrumentation. Using a valvulotome introduced into the apex of the ventricle he produced mitral and tricuspid regurgitation by cutting the leaflets, and he also created stenosis of the valves by tying a ligature around the



valve ring. He had several operative recoveries—not an easy task at that time. He also studied valve lesions occurring naturally in dogs and attempted to operate on one animal with mitral disease. His work was directed towards "a future surgery of the cardiac valves".

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